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the atmospheric oxygen and to the alkalescence of bog waters by aquatic plants. In rare instances the iron deposits may be made up almost entirely of the sheaths of the filamentous iron bacteria *Gallionella ferruginea* and *Leptothrix ochracea*. It may also be possible that deposits in which no bacteria may be found may have had their start by the growth of iron bacteria, but later on these may have died out and left no trace of their presence.

In regard to the formation of iron rust in water pipes, the author is in accord with the observations of the English investigator BROWN, and others, who believe that very often the incrustations of rust on the inner surface of the pipes may begin in areas accidentally left bare in the usual tarring process, and ferric oxid is formed by the action of the water entirely apart from the presence of iron bacteria, as the author himself has time and again demonstrated. It must be remembered, however, that where the presence of iron bacteria can be unequivocally established, there must occur the favorable combination of both soluble iron and organic food material; lacking the latter in sufficient quantity, no iron bacteria can gain a foothold.

MOLISCH very timely points out that much of the chalybeate waters bottled for medicinal purposes is worthless on account of the precipitation of the iron in insoluble form (ferric hydrate). This may be caused in one of two ways: (1) by the action of the air acting on the soluble iron carbonate, and (2) by the activities of one or other of the iron bacteria. This latter fact is established beyond a doubt, inasmuch as ADLER has cultivated iron bacteria from the waters of several chalybeate springs, and by the addition of various antiseptics has delayed the action of precipitation of the iron by inhibiting the growth of the bacteria. In practice such waters are recommended to be treated by filtration or by sterilization by heat.

The monograph is supplied with a full bibliography of the subject, and is plentifully illustrated with colored plates, original drawings, and photographs. The work constitutes a most valuable contribution to our knowledge of these peculiar and interesting microorganisms.—NORMAN MACL. HARRIS.

The morphology of gymnosperms²

In the present handsome volume the authors have more than doubled the size of their book on the same subject published almost a decade ago. It is a significant fact that the "fossil gymnosperms," relegated to an all too brief chapter in the earlier edition, are now distributed in accordance with their evolutionary sequence, and adequately and even copiously treated. The volume begins with the Cycadofilicales, as they are appropriately dubbed, in preference to the earlier and less suitable appellations Cycadofilices and Pteridospermeae. This group of gymnosperms, which has clearly emerged

² COULTER, J. M., and CHAMBERLAIN, C. J., Morphology of gymnosperms. pp. xi+458. figs. 462. Chicago: The University of Chicago Press. 1910. \$4.10, postpaid.

from the paleobotanical limbo only within the decade, is given full consideration from every standpoint, and the account is made clearer for the general reader by an admirable summary of the general principles of fern anatomy. Next follow the Bennettitales, a group which American science has done so much to rescue from oblivion. In this as in the preceding chapter the authors have illustrated their account with good figures from original sources, and here we find the work of WIELAND, WILLIAMSON, and NATHORST freely drawn upon, just as SCOTT, OLIVER, KIDSTON, and POTONIÉ furnish the figures for the first chapter on the Cycadofilicales.

The treatment of the Cycadales is particularly full, as might be expected, in view of the special interest of the Chicago laboratories in the group. The illustrations comprise not only the gametophytes, but also the anatomy, which is more comprehensively dealt with in this instance than in the case of any of the other gymnosperms. This chapter must rank as perhaps the best in the volume. The Ginkgoales occupy about 35 pages. An interesting illustration here is a tone print of the identical tree from the botanic garden of the University of Tokyo, in the seeds of which HIRASÉ made the surprising discovery of spermatozoids.

The Coniferales naturally receive more attention than any of the older gymnosperms, since they are the prevailing naked-seeded plants of our epoch, and moreover are the exclusive representatives of the phylum in temperate climates. In the 140 odd pages devoted to the Coniferales, the authors discuss the order under the appellations customary in systematic accounts. It seems desirable as soon as possible to get rid of the inapposite and cumbersome appellations Pinaceae and Taxaceae, inherited from the taxonomic side, and replace them by other terms more in accordance with evolutionary lines in the Coniferales. Perhaps the time is not yet entirely ripe for that to be done. Although the conventional bifurcation of the Coniferales is adopted, the authors do not fail to discuss the hypothesis recently put forward by SEWARD, PENHALLOW, and the reviewer as to more appropriate groupings. It is recognized that the araucarian conifers stand in a group by themselves as compared with the Abietinae, Taxodinae, and Cupressinae. The authors even go so far as to grant, what seems inadmissible from the paleobotanical side, that the Araucarineae and pinoid conifers may have had an altogether separate origin from the Cordaitales. Nothing can apparently be clearer than that the earliest remains which can be referred either to araucarineous or abietineous affinities, have all the characteristics of conifers. The treatment of the coniferous series is particularly worthy of praise for its thoroughness and many-sidedness. The bane of morphology in the past has been the setting up of evolutionary hypotheses based on the consideration of facts of a single kind. This error has certainly been avoided here. The external habit, the spore-producing members, the vascular anatomy, the sporangia, the gametophytes, and the history or paleontological record of the group have all been considered. The result is one which,

although not without prudent reservations, is clear and along stimulating and evolutionary lines, with a due emphasis of principles and the avoidance of meaningless facts. What is most to be commended, and unfortunately a rare feature in botanical textbooks, is the recognition that stable results in connection with plant evolution can be built only on the firm basis supplied by the record of the rocks. Perhaps the only criticism which might be made of the long chapter on the Conifers is that it does not include among its many and good illustrations some of the anatomy of the group, especially as the importance of this phase of the subject is clearly and adequately recognized in the text.

About 40 pages are given to that fascinating and still, in spite of many recent additions to our knowledge, enigmatical group, the Gnetales. Presenting as it does so many characters, which ally it both with the gymnospermous and angiospermous seed plants, it is at once the lure and the despair of the morphologist. The conclusion is reached that the Gnetales rather represent a line of development from the same ancestry as the angiosperms, than a primitive group from which the higher seed plants have directly taken their origin. The authors seem to look with some degree of tolerance at least on the view, which has originated in recent years from added knowledge of the floral structure of the Bennettitales, to the effect that the angiosperms and Gnetales are an offshoot of the cycadophyte stock. This view of relationship rests entirely on the enigmatical inflorescence of the Bennettitales, and appears to have no support from a consideration of the structure of the gametophytes or the internal anatomy. While entertaining the possibility of a Bennettitean origin of the Gnetales, the authors at the same time suggest a possible derivation from the Coniferales. This is perhaps a more fruitful hypothesis, which may be justified when we possess some real knowledge of the past history of the group.

The volume reviewed is a masterly treatment of our present knowledge of the gymnosperms, and resumes in a particularly clear and happy way, from every standpoint, the evidence as to their structure, affinities, history, and evolution. It is vastly creditable to American morphology, and the statement may safely be made that there is nowhere in existence, at the present time, a general account of the group which is so judicial and authoritative, without being dull, hazy, or uninteresting. It follows of course that it is indispensable to every student of this important group of plants.—E. C. JEFFREY.

Vegetation der Erde

The ninth volume of ENGLER and DRUDE's monumental work on the vegetation of the earth forms one of a series of monographic treatises that is to deal with the geographic features of the African flora.³ Although the volume

³ ENGLER, A., and DRUDE, O., Die Vegetation der Erde. IX. ENGLER, A., Die Pflanzenwelt Afrikas insbesondere seiner tropischen Gebiete. Band II. pp. xi+460. pls. 16. figs. 316. Leipzig: Wilhelm Engelmann. 1908. M 27 (subscription price M 18).